ADDRESS

TO THE

SUB-SECTION OF PHYSIOLOGY

OF THE

BRITISH ASSOCIATION.

BIRMINGHAM,

1865.

DELIVERED BY THE PRESIDENT,

HENRY W. ACLAND, M.D., F.R.S.,

HONORARY PHYSICIAN TO H. R. H. THE PRINCE OF WALES, REGIUS PROFESSOR OF MEDICINE IN THE UNIVERSITY OF OXFORD, ETC. ETC.

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Ladies and Gentlemen,—In addressing you from the Chair this day, I desire first of all to express my sense of the unmerited honour thus conferred upon me. When informed that it was intended to propose me as your Chairman, my first impulse was without hesitation to decline so great a distinction, in order that the post might be held by one of the many eminent persons who usually contribute to the success of the Section, or to the renown of the Department. Further consideration seemed to show me that the greater homage would be to place unreservedly at your service such humble powers as I have, and to offer you that which I possess, viz. the force of profound interest in the progress of one of the most important departments of human knowledge, and of sympathy all but lifelong with its promoters.

I rely, therefore, on the support which you will generously give to my endeavours to secure all full and fair discussion that is consistent with a due regard to the limited time at our disposal.

It has become a custom that the Presidents of Sections should make some opening address, though it is held to be inexpedient that it should be elaborate or long. While debating on the subjects on which I might usefully touch, I chanced to encounter the remark of a philosophic writer, that the time was come when it was a prime necessity for Biology that it should be separated from Medicine. The grounds alleged were, the imperfect education of physicians, their want of leisure, and the magnitude of biological science. There seemed to me such a mixture of truth and error in the remark itself, and in the general tenor of the data on which it was founded, that it appeared to me well worthy of your attention.

As to the imperfect education of physicians, the remark is too general to be correct, and is not a topic proper to be considered here, further than to say, 1st, that it is to great medical minds, from Hippocrates and Galen down to Haller and Hunter, that we owe the promotion, and, indeed, the very creation, of a large part of existing biological knowledge, so that these men cannot have been ill furnished for their work; and 2ndly, that it is certain that no persons who are not well prepared will in future make any additions of importance to this or any other department of science. The observation, therefore, on the whole, amounts to this, that in these days biological science has become too extensive to be committed to the care of any but those who can give to it

undivided attention. This also is only true under limitation. It is true so far as this, that division of labour is as neeessary for the perfeetion of this portion of science as of others; and further, that some parts of biology are beeome so complicated and so extensive as to demand for original work the whole powers of any man of ordinary ealibre. But it would be quite as just if we were to lay it down broadly, "There has been no period when it was as necessary for the progress of biology as now it is, that its relations with medicine should be closely maintained." Neither position would be wholly true, or, therefore, wholly safe. It may not be amiss to oecupy a short time at the outset of our detailed labours with a brief consideration of the real seope of the pursuit in whieh we are engaged, and of the means whieh we possess for attaining our objects. I erave your indulgenee if my analytieal description fall short of your distinet eoneeptions or your more sanguine aspirations.

The objects of biologieal study are, unquestionably, as in most other seienees, *First*, simply to aseertain what are the facts in a certain department of Nature, with no regard to the praetieal eonsequenees whieh ean be dedueible therefrom; and *Secondly*, but less direetly, to diseover the laws and devise the rules which are of various degrees of importanee and value for the practical exigencies of mankind,—just as mathematieal and physieal astronomers investigate the faets whieh are neeessary for the eonstruetion of the Ephemeris, and make it to be a work of equal value for the pure astronomer and for the praetieal navigator.

But some of the faets whieh physiology investigates, and the laws whieh it seeks to diseover, happen to be of cogent consequence to all men equally,—to the thoughtful and the eultivated, because they have the tendeney to illuminate the most hidden reeesses of our mental constitutions, the most obseure traees of our origin, and our various eorrelations to other beings, animate and inanimate; to the mere "hewers of wood and drawers of water" among men, beeause it seeks to aseertain in the most preeise manner the conditions of physieal existence, to point out the work that can, and that eannot, be done upon such and sueh an amount of sustenanee. In short, it seeks to define the exigeneies of the human body in respeet of all the external eireumstanees in whieh it is ordinarily plaeed, in respect also of all other physical agents that can aet upon, or be aeted upon by it; together with the internal ehemieal and physical alterations to whieh these several eireumstanees ean, directly or indirectly, give rise. It has to learn also the limits of toleration within which the body is confined by these external agents, and the way in which these limits are regulated—as the laws of toleration of elimate, of heat, of food, of various noxious agents, and many other partieulars, of whieh the catalogue would be greater than that of the ships of Homer.

Every person, therefore, whether he knows it or not—the Statesman, who has to consider the sustentation of the people—the Religious man (that is, every one who believes in a moral government of the world, or hopes for a future state, and who has opinions on the history or origin of the Human Raee)—the Animal man, who prides himself on his strength, or whose strength is to him for a fortune—the Mother, rieh or poor, who yearns by night and by day for the healthy growth of her tender offspring—the Physician or Philanthropist, who desires to avert or to relieve diseases among eommunities or individuals of men—each and all of these are alike really interested in the steady progress of the most abstruse philosophical speculations of the physiologist, as eertainly as of the commoner rules of a healthy life, whieh are to be safely dedueed from them.

In reference therefore to the opinion which was just now adverted to, I think that Biology is to be extrieated from the hands of physicians only in a limited sense. No persons have so many grounds for advaneing it as they. The physician, abstraetedly eonsidered, eombines all the eharacters to whieh I have alluded. He is, in respeet of the health of the people, a Statesman; as a Man, like others, a Religious man; not less than others, Father and Husband; as much as any, a Workingman; by education, more or less, a Man of Seienee. In short, abstraetedly eonsidered, I say it is his special duty at least to advocate and, if he can, to promote the advanee of physiological knowledge *unfettered and free*,—

1st. As a pure Seience.

2nd. As the basis of the Medieal Art.

3rd. As of practical utility in helping to regulate the lives and habits of society at large.

Now the hindrances to a perfectly free study of Physiological Science arise from two causes:—

1st. The intrinsic difficulty of the subject; and

2nd. The prejudices of mankind.

To the consideration of these two points it may not be useless for us to devote some attention.

1st. As to the intrinsic difficulty of the subject.

Although the wisdom of this Association entitles this Meeting a *Sub*-Section, I am among the minority who cannot understand the force of the arguments which go to class Biology (which term may be now used synonymously with Physiology) as a subordinate subject. Being, when properly considered, the most complicated of all the subject matter debated at this Association, it cannot be really subordinate to any, least of all to Zoology and Botany, which it distinctly *in*cludes. It may be an open question whether Physiology be a branch of Physics and Chemistry; it is not an open question whether it includes the knowledge of the characteristics upon which the classification of all entities that are said to have life is based.

It were an impertinence, however, now to spend time in arguing about the Classification of Sciences. It is sufficient for us to note the vast range of Biology, a range which every year makes more wide.

The knowledge of the actions of living beings depends, and necessarily depends, not only upon what may be learnt intrinsically, so to say, in the living beings themselves, but upon the collateral advancing waves of physical and chemical inquiry. How largely, for instance, in the last few years, have the idea of Conservation of Force in Physics, and the remarkable advance of the Synthetical operations of the Laboratory affected our fundamental conceptions of the actions in living bodies, and increased the chances of our advancing a step towards the knowledge of what is essential in the phenomena which we designate Life.

The intrinsic difficulty of this search in the present day consists not so much in the morphological examination of beings on the one hand as complex as Man with all his varieties, and the problems thereto attaching (though this morphological examination of Man in all his varieties is still incomplete), nor in the examination, on the other hand, of beings so inexplicably simple as our own *Amœba*, or as the ancient (and how ancient!) *Eozôon Canadense*, but in the causes and conditions of the actual or potential changes in the minutest portions of any one creature. The labours of Goodsir and Virchow and Beale, and of many others labouring in the same direction and in various ways, have shown, what was indeed long suspected, that the solution of the problem of the actual relation between Function and Organ may be sought, and has to be sought, among parts mechanically almost as fine as the Chemical Atom; for we have life, secretion, motion, generation in parts, to our present means of examination, structureless. Yet, although this may be the case, it would be a great error to suppose that there is not much work yet to be done in the more obvious department of Descriptive Anatomy which chiefly occupied older investigators. Every year seems to show this, from the researches of cultivated Palæontologists and Naturalists in every department: for both in this country and on the two continents additions are being unceasingly made to the stock of knowledge either of objects wholly new, or of objects or parts heretofore incompletely described.

For the purposes of the great scientific question of this age, the Causes of the present order of Life on the Globe, it would seem that the minutest accepted data of biological conclusion may have to be revised under new methods. It is a saying among painters, "that a draughtsman *sees* no more than he *knows*." It is true in the same way in Natural Science, that the real signification of a known fact may be concealed for ages. Of this, Pathology offers many examples. The older naturalists, notwithstanding the great learning of such men as Linnæus and Haller, had comparatively either very simple or hypothetical and incorrect notions of the complexities of living Beings and their constituent parts. Chemistry, the Microscope, and the search for the Origin of Species have, in this century, widened

the horizon of biological study in a way not less surprising than does the dawn of day to a traveller, who, having by night ascended some lofty peak, sees gradually unfolding an extent and detail of prospect which he can generally survey, though he cannot hope to verify each detail and visit every nook in the brief time allotted to him for travel. The desire "rerum cognoscere causas" urges him even more keenly than to know the things themselves. Thus in Biology, the laws of the genesis of every known organic being have now become as much the object of investigation as was once the nature of the being itself. The existence of definite species or varieties was formerly assumed in an arbitrary manner to be a kind of necessity. The search after the laws which produced those species, and the signification of them, has become as ardent as was once the definition of the specific characters. But it is a far more difficult pursuit, and requires either a very special education, or remarkable natural powers. The difficulty pervades every department of Biology in gross and in detail. Darwin seeks the solution for the whole kingdom of nature. The Histologist, the Pathologist, the Organic Chemist approaches it in the detail of every mechanical texture, and of every organic chemical compound. We are apt to look on the Museum of John Hunter as the most philosophic and extensive exposition of Biological Science in this or any other country. And justly so. Inquiring originally into what is the proper treatment of disease, he asks in order, What is its nature? what its cause? how are the functions disordered? how are they performed in health? by what mechanism? how is this mechanism varied? whence did it originate? But compare with his knowledge the knowledge of biologists of the present period viewed collectively: take our knowledge of the ovum, for instance, and its development, or the minute anatomy of the tissues, or (may I venture to use the epithet for so vast a collection of ascertained truth?) the *nascent* chemistry of living structures, or the relations of osseous structures in the Vertebrata. It were hard to say which is the more remarkable, Hunter's comprehensiveness, or the detail of modern science. Yet how many details are still needed for a safe Biological Philosophy.

Yet are we only on the threshold of detailed knowledge. We still speak of many hard points with an almost childlike simplicity. What do we understand, for instance, of the cause of that which Herbert Spencer calls "Organic Polarity"—that is to say, the power, force, or tendency by which lost parts are repaired—by which a whole limb—or part of a limb—or even all but a whole body is replaced by the outgrowth from what remains of the original unmutilated whole—a process so common in Asteriadæ and Crustacea and other animals as to seem a matter of course in their history, while it is apparently a property which cannot exist in the higher animals? What do we know of the causes of hereditary transmission *in general* (a property wholly different from, and more unintelligible, than the hypothesis of natural selection), or of the transmission of disease *in particular*, as for example, of Carcinoma? What is it in its essence? How does it originate in an individual of untainted family? How is it transmitted? Is it an original property of the ovum *per se*, or of the nutrient plasma by which that ovum is nourished up to the time of its birth? Could food, or mode of life, or any specific agent eradicate the tendencies to transmission, just as in certain cases we empirically modify the transmission of tubercle? or is the transmission of the Carcinoma as inevitable in certain cases as the development of the germ? Grave questions for future solution.

These allusions to disease, I need not say, are purposely introduced. There seems to be a tendency in some modern physiologists to pay insufficient attention to the retrograde metamorphosis of living creatures. The study of death is as much an object of biological science as the study of birth. The whole being originates, reaches maturity, declines, and dies. So does every part. He strives with vain endeavour to grasp the history of any organic thing, who does not regard it in relation to its origin, its growth, its dissolution, its relations to objects external to it, the changes which it undergoes in itself and of itself, and the modifications, accidental or necessary, which external agents can and may induce in it.

General considerations of this kind have a certain, though subordinate office in scientific deliberations, and seem just now not out of place. It will be remembered

that I have been speaking of the intrinsic difficulties of biological study. If I have correctly, though briefly, sketched the domain of Biology, the existence of these difficulties will be conceded. They are now insisted upon, not certainly so much for the sake of those skilled experts, our teachers, who are carrying on the conquest of Nature, as of those many cultivated learners who, from want of leisure, cannot actively pursue, but who, from real interest, desire to aid and promote the study of Biology. For them it is desirable to take from time to time a *general* survey of the aims and extent of Biology, in order that they may bring the weight of their influence in support—1st, of free, unfettered pursuit of Biology for its own sake; and 2ndly, of public education, such as may conduce in the next generation to a just appreciation of its scientific, its educational, and its practical value.

I am thus led to consider, 2ndly, the Prejudices of Mankind, "*opiniones præjudicatæ*," in respect of Biology.

These resolve themselves into Active Prejudices and Passive Prejudices. *Active* lead men to object to it as harmful; *Passive* lead them to regard it with indifference.

These prejudices are rapidly undergoing modification, but they have existed harmfully more or less, from various causes, among almost all but professed Physiologists. I need only advert among the *Active* prejudices to the so-called theological dread of free inquiry into the origin of Races, and the origin of Species generally. Among the *Passive* prejudices, I would point to the want of appreciation of purely scientific inquiry that has no practical end in view; to objections of various kinds brought against experiments made for Physiological, Toxicological or Therapeutical purposes; to objections to the introduction of Biological studies into courses of general education; to the tardy recognition of Biological knowledge as the basis of practical Medicine, and of Hygiene, public and private.

History gives the clue to the source of these prejudices, namely, the empirical assumptions of supposed truths made at former, and often ancient epochs, which have one by one to be eradicated from their respective departments before the advancing knowledge of ascertained Natural Law.

What we see around us in the natural world is admitted on all sides to be the result of the operations of causes working by fixed laws. Why those laws exist, or how they came to be, it is not within the domain of Physical Science to discuss. What (in so far as they affect living beings) they are, and what the mode and limit of their action, including (of course) the mode and limits of their possible modification, is the special province of Biological Science. Science therefore is not only at liberty, but is bound, at all times to test the correctness of opinions which bear on or have relations to the subject matter of science, and do not appear to have been founded on adequate scientific evidence. A great part of the scientific work in the present century has been that of recasting or rejecting received dogmas. This work is not yet complete, and possibly never will be. It is evident that new means of research show the incorrectness of the belief of many of the greatest minds. Plato was satisfied that the use of the Liver was to be the seat of prophetic agency for the soul. Yet are we sure that, notwithstanding the researches of Bernard, Pavy, and others, we know even at this moment all the functions and uses of that organ? How long since is it that taurine was found to contain 25 per cent. of sulphur, and was not, as had been supposed, devoid of that substance? How complicated are the chemical questions of the hepatic functions, when viewed as a whole throughout the animal series, may be seen by a glance at M. Milne-Edwards's summary of these questions in his elaborate work now in course of publication.

The utmost toleration is required in dealing with the prejudices which we are considering: among other reasons, because truly there may be scientific prejudices as well as popular prejudices. A scientific man may become impatient of every opinion which rests only on probability; whereas some of the important issues of human affairs are not susceptible of absolute proof. A physician or a lawyer, or a moralist, who always refused to act on the greater probability would be a sorry adviser to his client. But the work of the chemist or the physiologist would be at once set aside if probability and not ascertained fact entered into his formula.

Different subject matters are taught or studied with different degrees of certainty, or by different methods; the methods and degrees of certainty must be

known and acknowledged. There can be no just ground of objection to conclusions based on hypothesis so long as the promoters are ready to accept, on proper and reasonable evidence, new elements of calculation.

I spoke also of the Passive prejudices of mankind in respect of Biology. A curious chapter might be written on the slowness with which physiological principles have been generally received (I cannot say they are even now accepted by us) as the basis on which to secure public and private health. England is but even now awakening to these questions. The Registrar-General, the Army and Navy Departments, the Health Department of the Privy Council, the various Drainage Commissioners and Committees, and many other bodies are all engaged in collecting, disseminating, and in using physiological knowledge under various aspects. It it must be admitted that evidence as to what is and what is not favourable to the correct performance of the functions in men and other animals is even now often conflicting. It was said just now that the pure Physiologist is too apt to disregard the processes "*præparantes ad mortem*;" so also he is too apt to look on Health Questions as problems of Practice or Art, and not of Science. Yet the highest scientific qualities are requisite for determining with precision any problems affecting, for instance, Nutrition, and the consequent Capacity for labour of a population, viewed as a whole or as individuals: witness the investigations of your last year's President (now, happily, employed by the Government), and many of the important papers in Mr. Simon's valuable yearly Reports, and such memoirs as that of Professor Haughton of Dublin on *Work*. In such cases, I will not say *Theory*, but knowledge precedes, and regulates, and compels practice.

Similar considerations apply to the relation of Physiology to Practical Medicine. This art or science is undergoing revision under the influence of Physiology, a revision somewhat indeed retarded by popular prejudice, but certain.

In looking back on the history of medicine we are at a loss to say which is the more curious, the sagacity of the older physicians and surgeons, considering the scantiness of their physiological knowledge, or their folly, considering the extent of it. The explanation lies in the intermixture of empirical (that is, of accepted, traditional, unquestioned) belief with really ascertained fact; and we are not now-a-days without danger of undervaluing the eminent artistic power and great practical shrewdness of former physicians, in the presence of our more precise, but sometimes also less practically valuable scientific knowledge. Dr. Stokes, the eminent Dublin Professor, has lately spoken on this topic in a timely and earnest way.

The business of Physiology and of an Association like this, as I just now said, is therefore not only to add new knowledge, but to destroy incorrect or imperfectly correct statement and belief. The incorporation of advancing Physiology with Medicine every year adds certainty to the latter, while it furnishes data as well as tests to the former. Experiment properly applied in Medicine under trained physicists and chemists will not only eliminate gradually all remaining error, but will make more definite the properties of therapeutical agents. In illustration it is sufficient to refer to some of the investigations of Claude Bernard, from whose great skill, combined with philosophic power, much may be expected. Yet it may be doubted if the importance of this alliance between Science and Medicine to the community at large is yet fully understood by the Legislature. Under the recent Medical Act, the whole expense of constructing a National Pharmacopœia was thrown by Parliament on the existing Practitioners of Medicine, and the cost of its future maintenance was charged on the Students of Medicine: the national funds are to contribute nothing towards the great benefit, a benefit accruing to every one at some period of life, of a genuine and philosophical revision of known, or the discovery of new, curative agents. Experiment alone can decide conclusively on the mode of operation of various agents on the human body and on animals. These experiments are always difficult, often costly. The Government, as I said, do not acknowledge the duty of providing funds. Perhaps the Medical Council might. It is indeed charged with the administration of the only Public Funds that are applicable to keeping on a level with modern science the National Catalogue of Remedial Agents and the mode of preparing them. If it could be induced to expend £1000 a year, as under

proper management it easily might, in experiments and reports bearing on the physiological action of preventive or remedial agents, sometimes perhaps suggested and aided by the British Association, what might not be the fruit to science and to the public and private health?

I have been assuming, what no one here will question, that the basis of Medicine is knowledge of biological laws. It is so, but only in the wide sense assigned at the outset to biological pursuits; viz. the study of the laws of decay as well as of growth—growth and decay of species as well as of individuals. But I must guard myself by saying that this does not include the whole basis of medicine. Physiological experiment is necessary to obtain the laws of action on healthy bodies, but alone it does not explain the laws of action on perverted organic structures or functions, as is seen in the common instance of the different effect of opium on a man in health and on a man in disease. Clinical observation is of course beyond physiological research, and must, from its far more limited field, follow rather than precede. It aims at applying, in due course, all safe and established results of previous physiological inquiry; and adds the deductions from investigations exclusively its own.

Much remains to be done in comparing the effects of agents, and the causes of those effects on man and on the inferior animals respectively. The knowledge which exists on these subjects has become, I need not say, both extensive and precise. But new problems are constantly arising from the discovery of new Toxic agents. Even new diseases occur, as is well instanced by Cholera, implying either new conditions of circumstances external to man, or new combinations of the internal conditions of man.

Accordingly fresh experiments are perpetually required to meet the new problems; and it has become the interest and almost the duty of States to specially train and to countenance skilled experts familiar with the most recent methods and researches in these directions, with a view not only to fresh scientific knowledge, but to the great practical results that may be obtained. It is sufficient to refer as illustrations to Bernard's experiments, such as those on the Woorara—to the question of Physiological Antidotes—and to the more precise notions of the Physiological causation and mode of action of Fever Poison.

These you will observe, though apparently what are called medical questions, are not less physiological questions proper, of vast importance to mankind.

A few more words in another aspect, and I will not venture further to trouble the Section, or delay our detailed work, which is ample enough. I have implied, what is sufficiently obvious, that Physiology proper (I exclude such questions as the evolution hypothesis, which cannot be proved in this way) has become uncompromisingly precise, and that nothing will stand which does not bear the crucial tests of observation, and where possible of *experiment*. But the experiments cannot in the present advanced state of Physics and of Chemistry be devised by ordinary men, nor even executed by them. Consequently every year old statements concerning the effects of agents so called Physiological and Therapeutical, are becoming of less value, and new ones of more. Most of us, who have passed the prime of life, must be content to learn from the more favoured in years. They who are young must be willing to be patient and laborious, if they would add any thing of permanent value to physiological knowledge. The day in which hundreds of organic compounds are synthetically produced, and the microscope offers for mechanical analysis a clearly defining magnifying power of 5000 linear, is not one when rough work of hand, or conjecture unsupported by proof as to the chemical changes which go on within organic structures, will stand. What Life is will long, perhaps always evade our human ken; what is done during Life, what can be done consistently with Life, and what produces death among living things, every year makes more sure and more plain; every year makes the search more exciting, the reward more great, the reasons for admiration of the order of things on the whole more conclusive, and the admiration and awe more profound.

At the outset it was said that only very qualified assent could be given to the remark of a philosophical writer, that it is a prime necessity for Biology that it should be separated from Medicine. It has been my endeavour to show the amount of truth which belongs respectively to the remark and to the dissent.

Physiology, to sum up, is become a scienee, preeise, of enormous extent, bringing to its support mathematies, advanced physies, diffieult ehemistry, aeeurate and eomprehensive anatomy. Part of the basis of the seienee or art, which averts or lessens suffering and disease, and postpones or makes easy death, depends in great measure upon its progress. But the applied and observational part ean only be learned by the bed-side of the siek. Therefore pure Biologieal Seience and pure Clinical Art must eaeh have their votaries, but it must be the aim of eaeh to learn from the other what is necessary for himself. May the State be wise enough (and it is beeoming so in every eivilized country) to appreeiate these principles and their applieation! There never was an age—it is not ungrateful to the giants of old to say this—there never was an age when there were so many students, in the best sense, of Biology and of Medieine, actuated by a simple love of truth; and never a time when, as a class, they were so free from prejudice, so candid, and so patient.



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